**RESEARCH PAPER**

# Functional Outcomes of Phalanx Base Fractures of The Hand Managed with The Suzuki Dynamic External Fixator: A Prospective Observational Study

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**ABSTRACT**

**Background:** Phalanx base fractures involving the proximal interphalangeal (PIP) joint are unstable injuries associated with stiffness and functional impairment if not treated appropriately. Dynamic external fixation using the Suzuki pins-and-rubber traction system provides ligamentotaxis, maintains fracture alignment, and allows early joint mobilisation.

**Objective:** To evaluate the functional and radiological outcomes of phalanx base fractures of the hand managed with the Suzuki dynamic external fixation technique.

**Methods:** This prospective observational study was conducted in the Department of Orthopaedics at Shri Sathya Sai Medical College and Research Institute, Tamil Nadu, India, between March 2024 and October 2025. Thirty-five adult patients with closed phalanx base fractures treated using the Suzuki dynamic external fixator were included. Baseline evaluation included radiographic assessment, goniometric measurement of metacarpophalangeal (MCP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joint motion, Total Active Motion (TAM), Sollerman Hand Function Test, and Visual Analogue Scale (VAS) for pain. Follow-up assessments were performed at 1, 2, 3, 4, and 6 weeks. Statistical analysis was conducted using SPSS version 29.

**Results:** The majority of patients were males (77.1%), with the 31–40-year age group most affected (34.3%). Most fractures were intra-articular (85.7%) with PIP involvement (94.3%). Mean PIP motion improved from 17.0° at baseline to 85.2° at 6 weeks, while TAM increased from 63.4° to 214.2° ($p < 0.001$). Mean VAS pain scores decreased from 7.2 to 0.4, and the Sollerman functional score improved from 42.6 to 74.7 ($p < 0.001$). Early mobilisation was achieved in 85.7% of patients and was associated with faster return to activities of daily living. Radiological union occurred in 82.9% by 6 weeks and in all patients by 8 weeks. Most patients (74.3%) had no complications; superficial pin-site infection was the most common (17.1%).

**Conclusion:** The Suzuki dynamic external fixation technique is a safe and effective method for managing phalanx base fractures, allowing early mobilisation, reliable fracture healing, and significant functional recovery with minimal complications.

**Keywords**: Phalanx base fracture; Suzuki frame; dynamic external fixation; PIP joint; early mobilisation.

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## INTRODUCTION

Hand fractures represent a significant proportion of musculoskeletal injuries, accounting for nearly 10%–30% of all fractures, with an incidence of approximately 3.7 per 1,000 males and 1.3 per 1,000 females annually [1,2]. The majority of these injuries occur in young, active individuals exposed to road traffic accidents, sports injuries, machinery-related trauma, or falls [3,4]. Although mortality associated with hand fractures is negligible, the resulting functional impairment can be considerable, often leading to reduced hand function, limitations in daily activities, psychological distress, and a significant decline in quality of life [5].

Phalanx base fractures especially intra-articular injuries involving the proximal interphalangeal (PIP) joint are clinically important because of the complex anatomy of the joint and the limited soft-tissue envelope [6]. Inadequate or delayed treatment can lead to malunion, joint incongruity, chronic pain, instability, and severe stiffness [7]. Freiberg's classic observation that "for every case of delayed or non-healing fracture, there are at least a hundred permanently stiff fingers" highlights that **stiffness,** not non-union, is the major long-term complication in digital injuries. Therefore, prompt diagnosis, anatomical reduction, and **early mobilisation** are essential [8].

The principles of treating phalanx base fractures include restoring articular congruity, maintaining joint alignment and stability, preserving soft tissues, and initiating early range of motion to prevent adhesions and contractures [9]. Multiple treatment options have been described, such as buddy taping and extension-block splinting for stable fractures; closed reduction and percutaneous K-wire fixation; static external fixation; open reduction and internal fixation (ORIF) using screws or plates; Schenck dynamic traction; the Hynes and Giddings device; volar plate arthroplasty; and dynamic traction devices [4]. However, each method has its own limitations.

To address these limitations, Suzuki et al. introduced the pins-and-rubber traction system (PRTS), commonly known as the Suzuki dynamic external fixator. This technique uses ligamentotaxis to maintain fracture alignment while allowing controlled distraction and early joint motion. By combining stability with early mobilization, the technique promotes cartilage nutrition, osteochondral healing, and functional recovery. [10].

Multiple authors have reported excellent or good functional outcomes with the Suzuki dynamic external fixation technique, with acceptable complication rates predominantly consisting of superficial pin-tract infections; [11-13]. However, most available studies are retrospective, involve small sample sizes, mix different fracture types, or lack uniform rehabilitation protocols [14,15]. There remains limited prospective data focused specifically on **phalanx base fractures of the hand** treated with the Suzuki procedure, particularly in the Indian clinical context. This creates a significant research gap in understanding functional outcomes, complication patterns, and the reproducibility of results in a standardised setting.

Therefore, the present study aims to address this gap by prospectively evaluating range of motion, pain relief, radiological alignment, functional recovery, and complication rates following Suzuki frame application in phalanx base fractures. The study seeks to contribute evidence on whether dynamic ligamentotaxis with early mobilisation truly offers superior outcomes in these challenging injuries.

## METHODS

### Study design and setting

This prospective observational study was conducted in the Department of Orthopaedics at Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpattu District, Tamil Nadu, India. The study was carried out over an 18-month period from March 2024 to October 2025. Ethical approval was obtained from the Institutional Human Ethics Committee of the institution (IEC No.: 1006/24). Written informed consent was obtained from all participants before enrolment in the study.

### Participants

Adult patients presenting with phalanx base fractures of any finger of the hand and planned for treatment with the Suzuki dynamic external fixation technique were included in the study. The inclusion criteria were patients aged more than 18 years with closed phalanx base fractures of any finger. Patients younger than 18 years, those with open fractures, fractures involving two adjacent fingers, elderly patients above 80 years, pregnant women, physically disabled individuals, and mentally challenged individuals were excluded. A convenience sampling method was used, and all eligible patients presenting during the study period were consecutively enrolled.

### Sample size

The sample size was calculated based on a previously published study by Özdemir E et al (2025) [15]., which reported a mean DASH score of 2.3 ± 1.8. With a precision of 0.6 and a 95% confidence level, the minimum required sample size was calculated using the formula:

$$n = \frac{(Z_{1-\alpha/2})^2 \sigma^2}{d^2}$$

where σ represents the standard deviation, d represents the allowable error, and $Z_{1}$-α/2 represents the standard normal deviate at a 95% confidence level (1.96). The calculated minimum sample size was 35 participants.

### Study procedure

All patients underwent a detailed preoperative evaluation including history taking, clinical examination, and radiological assessment using anteroposterior and lateral

radiographs of the affected finger. Baseline functional assessment was performed using the Sollerman Hand Function Test [16], and range of motion of the metacarpophalangeal (MCP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joints was measured using a goniometer [17]. Total active motion (TAM) was also calculated.

**Surgical technique**

All patients were treated with the Suzuki dynamic external fixation technique using the pins-and-rubber band traction system. The procedure was performed under regional anaesthesia with standard sterile precautions. Intravenous cefuroxime (1.5 g) was administered 30 minutes before surgery as prophylactic antibiotic cover. After achieving closed reduction using the principle of ligamentotaxis, three Kirschner wires were inserted. A 1.2 mm K-wire was passed transversely through the head of the proximal phalanx just proximal to the PIP joint and bent to form hooks, functioning as the axial traction pin. A second 1.0 mm K-wire was inserted transversely through the head of the middle phalanx to serve as the distal anchoring pin. A third K-wire was inserted distal to the fracture site to maintain fracture alignment and correct any dorsal or volar subluxation. Rubber traction bands were applied between the hooks of the proximal and distal pins to provide controlled distraction and ligamentotaxis, thereby maintaining fracture reduction while allowing early joint mobilisation.

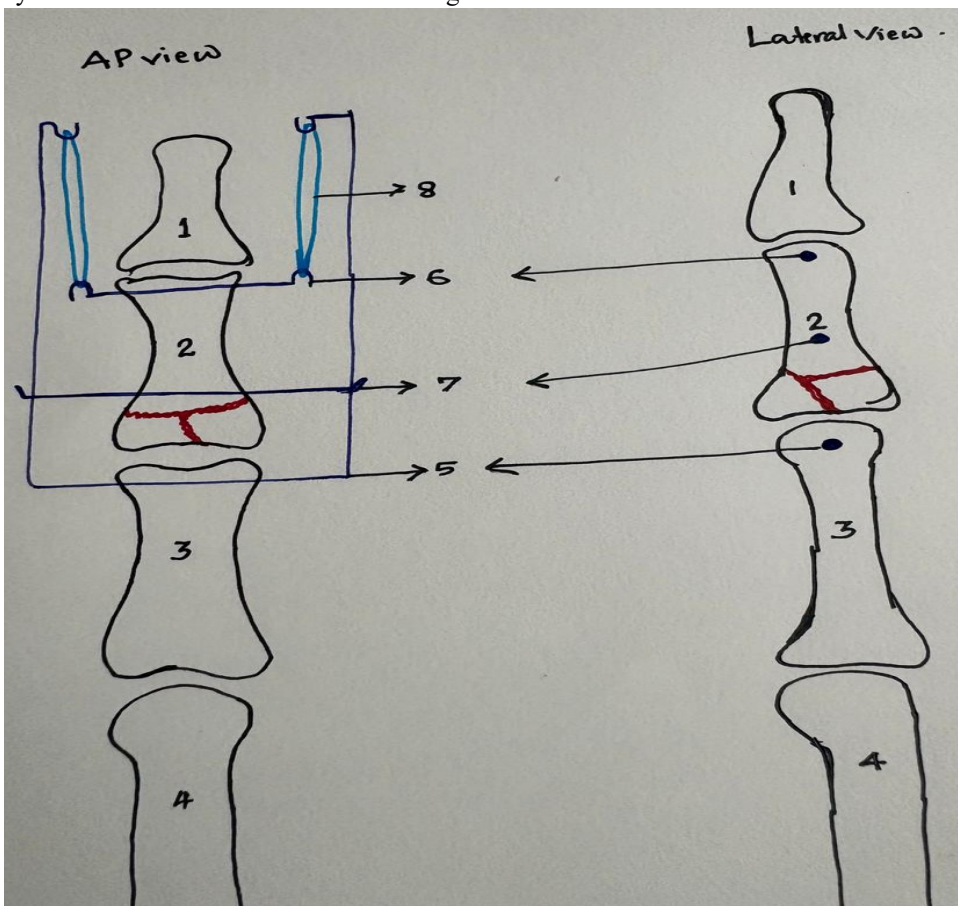


**Figure 1:** Diagram of Suzuki's frame for fracture of the base of the middle phalanx—(1) distal phalanx, (2) middle phalanx, (3) proximal phalanx, (4) metacarpal bone, (5) axial traction pin, (6) hook pin, (7) reduction pin, (8) rubber band traction

**Post-operative care and follow-up**

Post-operatively, pin sites were cleaned and sterile dressings were applied according to institutional protocol. Active range-of-motion exercises of the PIP and DIP joints were initiated immediately after surgery. Patients were discharged on the same day and followed up at 2, 4, and 6 weeks. Radiographs were obtained on the immediate postoperative day and during each follow-up visit to assess fracture alignment and healing.

**Outcome measures**

The primary outcomes evaluated were fracture healing, anatomical alignment, functional outcome, and procedure-related complications such as pin-site infection, subluxation, and soft-tissue complications. Functional performance was assessed using the Sollerman Hand Function Test [16], which evaluates eight standardized hand grips commonly used in activities of daily living. Range of motion of the MCP, PIP, and DIP joints was measured using a goniometer, and total active motion was calculated as the sum of flexion minus extension deficit [17].

**Statistical analysis**

All data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS) version 29. Categorical variables were expressed as frequency and percentage, while continuous variables were presented as mean ± standard deviation. Paired t-tests were used to compare baseline values with follow-up measurements. A p-value of less than 0.05 was considered statistically significant.

**Table 1:** Baseline Demographic and Clinical Characteristics of Study Participants (n = 35)

| Variable | Category | Frequency (n=35) | Percentage (%) |
|---|---|---|---|
| **Age (years)** | 18–30 | 10 | 28.6 |
| | 31–40 | 12 | 34.3 |
| | 41–50 | 8 | 22.9 |
| | >50 | 5 | 14.3 |
| **Gender** | Female | 8 | 22.9 |
| | Male | 27 | 77.1 |
| **Hand involved** | Right | 20 | 57.1 |
| | Left | 15 | 42.9 |
| **Dominant hand** | Right | 30 | 85.7 |
| | Left | 5 | 14.3 |
| **Finger involved** | Index | 6 | 17.1 |
| | Middle | 14 | 40.0 |
| | Ring | 9 | 25.7 |
| | Little | 6 | 17.1 |
| **Mechanism of injury** | Road traffic accident | 14 | 40.0 |
| | Sports injury | 8 | 22.9 |
| | Fall | 7 | 20.0 |
| | Machinery / crush injury | 6 | 17.1 |
| **Type of fracture** | Extra-articular | 5 | 14.3 |
| | Intra-articular (non-comminuted) | 12 | 34.3 |
| | Intra-articular (comminuted) | 18 | 51.4 |
| **Joint involved** | PIP | 33 | 94.3 |
| | DIP | 2 | 5.7 |
| **PIP subluxation** | Present (dorsal) | 29 | 82.9 |
| | None | 6 | 17.1 |

Table 1 shows the distribution of study participants based on Demographic and Clinical Characteristics. Among the 35 study participants, the majority were aged 31–40 years (12; 34.3%), followed by 18–30 years (10; 28.6%). Most participants were male (27; 77.1%). The right hand was involved in 20 (57.1%) cases, and 30 (85.7%) participants were right-hand dominant. The middle finger was most commonly affected (14; 40.0%). The most frequent mechanism of injury was road traffic accident (14; 40.0%), followed by sports injury (8; 22.9%). Regarding fracture pattern, intra-articular comminuted fractures were the most common (18; 51.4%). The proximal interphalangeal (PIP) joint was involved in 33 (94.3%) cases, and dorsal PIP subluxation was present in 29 (82.9%) participants.

**Table 2:** Improvement in Range of Motion Following Suzuki Procedure

| Time point | PIP (°) Mean ± SD | DIP (°) Mean ± SD | MCP (°) Mean ± SD | TAM (°) Mean ± SD | p value |
|---|---|---|---|---|---|
| Baseline | 17.0 ± 8.8 | 12.7 ± 6.4 | 29.5 ± 8.4 | 63.4 ± 25.6 | — |
| Week 1 | 43.5 ± 8.2 | 26.2 ± 6.1 | 44.4 ± 10.7 | 104.1 ± 18.8 | <0.001* |
| Week 2 | 54.5 ± 11.4 | 34.6 ± 8.7 | 50.2 ± 9.1 | 144.9 ± 21.2 | <0.001* |
| Week 3 | 65.8 ± 10.9 | 46.4 ± 7.2 | 53.9 ± 7.5 | 170.2 ± 25.9 | <0.001* |
| Week 4 | 72.6 ± 8.2 | 55.2 ± 7.7 | 57.4 ± 7.5 | 196.0 ± 23.2 | <0.001* |
| Week 6 | 85.2 ± 6.7 | 65.9 ± 7.3 | 61.3 ± 8.4 | 214.2 ± 20.9 | <0.001* |

Table 2 shows the improvement in range of motion following the Suzuki procedure. The mean PIP flexion increased significantly from 17.0 ± 8.8° at baseline to 85.2 ± 6.7° at week 6. Similarly, DIP flexion improved from 12.7 ± 6.4° to 65.9 ± 7.3°, while MCP flexion increased from 29.5 ± 8.4° to 61.3 ± 8.4° over the 6-week follow-up period. The total active motion (TAM) also showed marked improvement from 63.4 ± 25.6° at baseline to 214.2 ± 20.9° at week 6. These improvements across all follow-up intervals were statistically significant ($p < 0.001$), indicating substantial recovery in finger joint mobility following treatment.

**Table 3:** Pain and Functional Outcome scores during follow-up

| Time point | VAS score (Mean ± SD) | Sollerman score (Mean ± SD) | p value |
|---|---|---|---|
| Baseline | 7.2 ± 1.4 | 42.6 ± 7.1 | — |
| Week 1 | 4.9 ± 0.8 | 55.0 ± 7.3 | <0.001* |
| Week 2 | 3.3 ± 1.0 | 61.7 ± 7.2 | <0.001* |
| Week 3 | 2.1 ± 0.7 | 69.3 ± 4.7 | <0.001* |
| Week 4 | 1.2 ± 0.5 | 72.5 ± 3.9 | <0.001* |
| Week 6 | 0.4 ± 0.5 | 74.7 ± 4.3 | <0.001* |

Table 3 shows the changes in pain and functional outcome scores during follow-up. The mean VAS score decreased significantly from 7.2 ± 1.4 at baseline to 0.4 ± 0.5 at week 6, indicating a marked reduction in pain. Concurrently, the mean Sollerman score improved from 42.6 ± 7.1 at baseline to 74.7 ± 4.3 at week 6, reflecting substantial improvement in hand function. The changes observed at all follow-up intervals compared with baseline were statistically significant ($p < 0.001$).

**Table 4:** Mobilisation and functional recovery outcomes

| Variable | Category | n (%) |
|---|---|---|
| Start of mobilisation | Post-op Day 1 | 20 (57.1) |
| | Post-op Day 2 | 10 (28.6) |
| | Post-op Day 3 | 5 (14.3) |
| Mean time to mobilisation | 1.7 ± 0.7 days | |
| Mobilisation status | Early | 30 (85.7) |
| | Delayed | 5 (14.3) |

Table 4 shows the mobilisation characteristics of the study participants. Mobilisation was initiated on post-operative day 1 in 20 (57.1%) patients, followed by day 2 in 10 (28.6%) and day 3 in 5 (14.3%) patients. The mean time to initiation of mobilisation was 1.7 ± 0.7 days.

**Table 5:** Comparison of early mobilisation and Functional Recovery (n = 35)

| Outcome | Early mobilisation (n=30) | Delayed mobilisation (n=5) | p value |
|---|---|---|---|
| Time to return to ADL (weeks) | 6.6 ± 1.2 | 8.4 ± 1.5 | 0.004 |
| TAM at Week 6 (°) | 214.3 ± 17.2 | 191.6 ± 19.4 | 0.01 |
| Sollerman score | 75.1 ± 3.9 | 69.8 ± 4.4 | 0.02 |

Table 5 shows the comparison between early and delayed mobilisation with respect to functional recovery outcomes. Participants who underwent early mobilisation demonstrated a significantly shorter time to return to activities of daily living (6.6 ± 1.2 weeks) compared to those with delayed mobilisation (8.4 ± 1.5 weeks), with this difference being statistically significant ($p = 0.004$). Additionally, early mobilisation was associated with significantly higher total active motion at week 6 (214.3 ± 17.2° vs. 191.6 ± 19.4°, $p = 0.01$) and better hand function as reflected by higher Sollerman scores (75.1 ± 3.9 vs. 69.8 ± 4.4, $p = 0.02$).

**Figure 2:** Radiological Outcomes of study participants

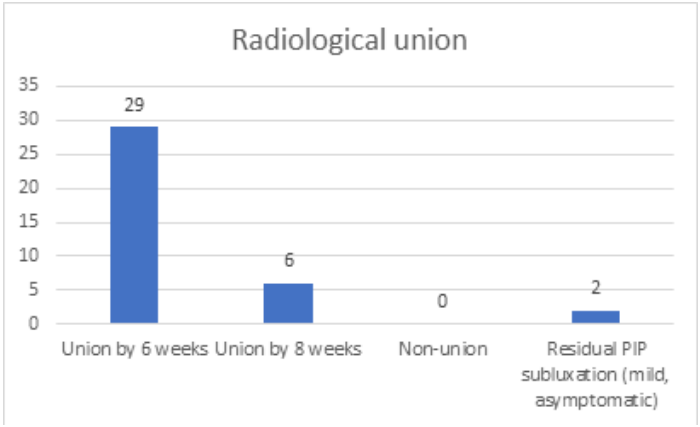


Figure 2 shows the radiological outcomes among the study participants. Radiological union by 6 weeks was achieved in the majority of participants, accounting for 29 (82.9%) cases, while the remaining 6 (17.1%) participants achieved union by 8 weeks. No cases of non-union were observed in the study. Additionally, mild and asymptomatic residual PIP subluxation was noted in 2 (5.7%) participants.

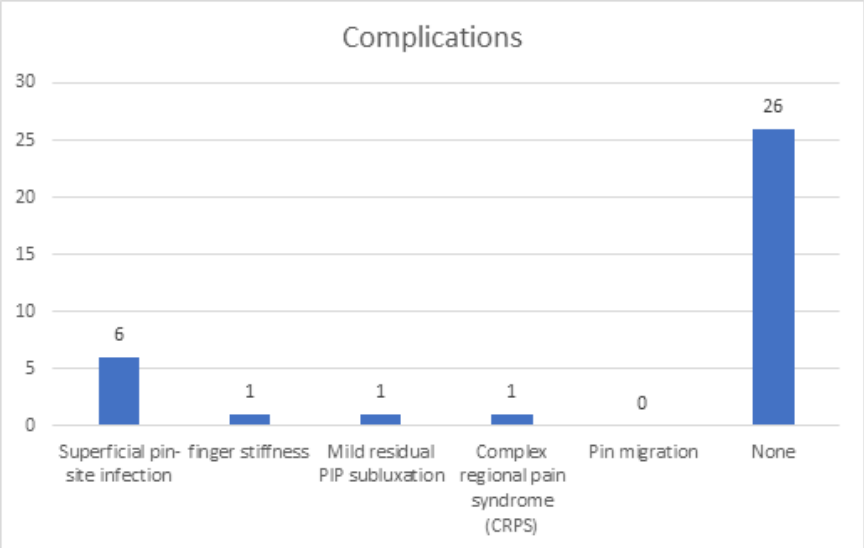


**Figure 3:** Post-operative Complications of study participants

The majority of participants experienced no complications, accounting for 26 (74.3%) cases. Superficial pin-site infection was the most common complication, observed in 6 (17.1%) participants. Finger stiffness, mild residual PIP subluxation, and complex regional pain syndrome (CRPS) were each noted in 1 (2.9%) participant. The details were depicted in figure 2.

## DISCUSSION

The findings demonstrated significant improvement in joint mobility, functional recovery, and pain reduction following treatment. Early mobilisation facilitated by the dynamic external fixator was associated with faster return to activities of daily living and improved functional outcomes. Radiological union was achieved in all patients and the overall complication rate was low, indicating that the Suzuki technique provides stable fracture fixation while allowing early controlled motion.

The demographic profile of the study population showed a predominance of young and middle-aged adults, particularly in the 31–40-year age group, with a clear male predominance. This pattern is consistent with previous studies reporting higher incidence of phalangeal fractures among active males exposed to occupational and sports-related injuries [14,18-21]. The right hand and middle finger were most frequently involved, which may reflect the vulnerability of the dominant hand during trauma. Similar findings have been reported by Bhat NA et al. and Wani MR et al [18,19]., whereas other studies have described greater involvement of the index or ring finger [15,22]. Such variations likely reflect differences in mechanisms of injury and occupational exposure across populations.

Most fractures in the present study were intra-articular and involved the proximal interphalangeal joint, with a high proportion of dorsal subluxation. These findings highlight the unstable nature of phalanx base fractures and emphasise the need for treatment methods that restore articular congruity while preserving joint mobility. The Suzuki dynamic external fixation system addresses this challenge by utilising ligamentotaxis to maintain reduction while permitting early mobilisation.

A progressive and statistically significant improvement in joint range of motion was observed throughout the follow-up period. The mean PIP joint motion improved from 17.0° at baseline to 85.2° at 6 weeks, while total active motion increased markedly. These findings are consistent with Wani MR et al. reported a mean PIP range of motion of approximately 85°, while Bhat NA et al. documented a mean of 80° [19,20]. Similar results have also been described by Bayoumy EM et al. and Özdemir E et al., indicating that dynamic external fixation consistently achieves PIP mobility in the range of 80–90° [15,21]. The early restoration of motion observed in this study likely reflects the ability of the Suzuki frame to maintain joint alignment while allowing early controlled movement, thereby reducing the risk of stiffness.

Functional outcomes also improved significantly following treatment. The mean Sollerman Hand Function Score increased substantially, while pain levels measured using the visual analogue scale decreased markedly. These results indicate effective restoration of hand function during the early postoperative period.

Comparable improvements in functional outcomes have been reported in previous studies using various scoring systems, including the Sollerman Hand Function Test [23], Michigan Hand Outcomes Questionnaire [21], and QuickDASH score [15]. Across these studies, patients treated with the Suzuki technique consistently demonstrate substantial functional recovery and low levels of residual disability.

Early mobilisation played an important role in the functional recovery observed in this study. Mobilisation was initiated within a few days after surgery in most patients, and those who underwent early mobilisation achieved better functional outcomes and earlier return to activities of daily living. This supports the biomechanical advantage of the Suzuki frame, which provides sufficient

stability to maintain reduction while allowing safe joint motion. Early movement helps maintain tendon gliding, improves cartilage nutrition, and reduces the risk of capsular contracture and joint stiffness.

Radiological outcomes were favourable, with fracture union achieved in the majority of patients by six weeks and in all patients by eight weeks. Only minimal residual subluxation was observed in a small proportion of cases. These findings are comparable to those reported in other studies [15,21,22], where high union rates and satisfactory alignment have been consistently achieved using dynamic external fixation techniques.

In the present study, the overall complication rate was low, with 74.3% of patients experiencing no adverse events. The most common complication was superficial pin-site infection (17.1%), which was effectively managed with local wound care and oral antibiotics, resolving within one week without further sequelae. Isolated cases (2.9% each) of complex regional pain syndrome (CRPS) and finger stiffness were observed; both responded well to conservative management with NSAIDs and structured physiotherapy initiated at 4 weeks postoperatively, with satisfactory recovery by 6 weeks. Mild residual PIP subluxation was noted in one patient (2.9%) and was attributed to loosening of the rubber band tension. In this case, the traction was readjusted by increasing the rubber band tension and the frame was retained for an extended period of 8 weeks (instead of the routine 6 weeks), resulting in restoration of alignment and clinical improvement. No cases of deep infection, osteomyelitis, or pin migration were encountered, highlighting the favourable safety profile and manageable complication spectrum associated with the procedure.

Similar studies have reported higher complication rates, including 39.13% by Bhat NA et al. [18], 37.5% by Kumar R et al. [14], and 30% by Bayoumy EM et al. [21], while Patil VB et al. reported complications such as malunion and residual subluxation [19]. In contrast, Kothiyal P et al. and Özdemir E et al. reported relatively low complication rates of approximately 3% and 6.6%, respectively [15,23]. Overall, these findings support the Suzuki frame as a safe technique with complications largely limited to minor and manageable pin-site infections.

Regarding limitations the study involved a relatively small sample size and was conducted at a single centre, which may limit the generalisability of the results. In addition, the follow-up period was relatively short, and therefore long-term outcomes such as late stiffness or post-traumatic arthritis could not be assessed. The absence of a comparison group also limits the ability to directly compare this technique with other treatment modalities such as open reduction and internal fixation.

## CONCLUSION

The study demonstrates that the Suzuki dynamic external fixation technique is an effective and reliable method for the management of phalanx base fractures of the hand. The technique provides stable fracture fixation while allowing early controlled mobilisation, resulting in significant improvement in joint range of motion, functional outcomes, and pain reduction. Radiological union was achieved in all patients with a low incidence of complications, most of which were minor and manageable. Early mobilisation facilitated by the dynamic fixator was associated with faster return to activities of daily living and improved functional recovery. Overall, the Suzuki frame represents a minimally invasive and function-preserving treatment option for unstable intra-articular phalanx base fractures.

## REFERENCES

1. Popova D, Welman T, Vamadeva SV, Pahal GS. Management of hand fractures. Br J Hosp Med (Lond). 2020;81:1-11.
2. Yoon YC, Baek JR. Current concepts of fractures and dislocation of the hand. J Musculoskelet Trauma. 2016;29:143-159.
3. Butt WD. Fractures of the hand: I. Description. Can Med Assoc J. 1962;86:731-735.
4. Thuppad AU, Lakshith BR, Shetty SK, Nazareth EL, Sheethal KS. Dynamic Suzuki frame for the interphalangeal joint fracture: A case report. Int J Orthop Sci. 2023;9(2):131-134. doi:10.22271/ortho.2023.v9.i2b.3361.
5. Ghițan AF, Gheorman V, Pîrvu D, Gheorman V, Udriștoiu I, Ciurea ME. A review of psychological outcomes in patients with complex hand trauma: A multidisciplinary approach. Curr Health Sci J. 2023;49(2):143-150. doi:10.12865/CHSJ.49.02.143.
6. Kamnerdnakta S, Huetteman HE, Chung KC. Complications of proximal interphalangeal joint injuries: Prevention and treatment. Hand Clin. 2018;34(2):267-288. doi:10.1016/j.hcl.2017.12.014.
7. Al-Jasser FS, Mandil AM, Al-Nafissi AM, Al-Ghamdi HA, Al-Qattan MM. Epidemiology of pediatric hand fractures presenting to a university hospital in Central Saudi Arabia. Saudi Med J. 2015;36(5):587-592.
8. Freiberg A. Management of proximal interphalangeal joint injuries. Can J Plast Surg. 2007;15(4):199-203. doi:10.1177/229255030701500407.
9. Bishay J, Davies M, Thompson M, Sathasivam S. Suzuki frame for complex base of thumb proximal phalanx fractures. Plast Reconstr Surg Glob Open. 2025;13:e6680. doi:10.1097/GOX.0000000000006680.
10. Suzuki Y, Matsunaga T, Sato S, Yokoi T. The pins and rubbers traction system for treatment of comminuted intraarticular fractures and fracture-dislocations in the hand. J Hand Surg Br. 1994;19:98-107.

11. Ruland RT, Hogan CJ, Cannon DL, Slade JF 3rd. Use of a dynamic distraction external fixation device for proximal interphalangeal joint fracture-dislocations. J Hand Surg Am. 2004;29(5):847-854. doi:10.1016/j.jhsa.2004.04.013.

12. Deshmukh SC, Kumar D, Mathur K, Thomas B. Complex fracture-dislocation of the proximal interphalangeal joint of the hand: Results of a modified pins and rubbers traction system. J Bone Joint Surg Br. 2004;86(3):406-412. doi:10.1302/0301-620X.86B3.14350.

13. Fouad A, Hegazy G, Seddik M, Safwat H, Negm M, El-Sebaey I. Treatment of proximal interphalangeal joint fractures by a modified dynamic Kirschner wire traction fixator. Orthop Rheumatol Open Access J. 2016;2(2):555582. doi:10.19080/OROAJ.2016.02.555582.

14. Kumar R, Kumar A, Shanker A, Kumar R. Suzuki frame results in the treatment of comminuted phalanx fractures. J Orthop Dis Traumatol. 2023;6(3):209-212. doi:10.4103/jodp.jodp_85_23.

15. Özdemir E, Altay N, Topsakal FE, Koçaslan M, Karabak B, Demirel E. Functional outcomes of miniplate/screw versus Suzuki frame fixation in Eaton type III middle phalanx base fractures: A case series. J Hand Surg Glob Online. 2025;8(1):100866. doi:10.1016/j.jhsg.2025.100866.

16. Sollerman C, Ejeskär A. Sollerman hand function test: A standardized method and its use in tetraplegic patients. **Scand J Plast Reconstr Surg Hand Surg.** 1995;29:167-176.

17. American Society for Surgery of the Hand. Clinical assessment recommendations. **J Hand Surg Am.** 1983;8(5 Pt 2):709-711.

18. Bhat NA, John M, Lone ZA, Bhat TA, Ghani A, Butt MF, Gupta S. Middle phalanx base fractures managed with Suzuki frame: A series of 23 patients. **Int J Res Orthop.** 2023;9(2):267-271. doi:10.18203/issn.2455-4510.IntJResOrthop20230023.

19. Patil VB, Gandhi KL, Dhurve KH. Study of functional outcome in patients with fracture dislocations at proximal interphalangeal joints managed with simple traction device. **Int J Acad Med Pharm.** 2023;5(3):1393-1397.

20. Wani MR, Qayoom I, Pandit HH. Suzuki frame in the management of intra-articular fracture of base of the middle phalanx. **JK Pract.** 2025;30(2-3):20-23.

21. Bayoumy EM, Eltramcy MS. Treatment of intra-articular phalangeal fractures of the hand by Suzuki frame external fixator. **Egypt Orthop J.** 2023;57:292-300.

22. Chatterjee B, Kumar D. Suzuki frame as a treatment modality for PIP joint fractures. **J Evid Based Med Healthc.** 2020;7(2):87-91.

23. Kothiyal P, Vij K, Gautam P, Ahuja Y. Functional outcome assessment in neglected proximal interphalangeal joint dislocation managed by dynamic Suzuki frame external fixator. **J Orthop Traumatol Rehabil.** 2024;16:125-129.